Domain Coarsening and Aging in Dislocation Glasses
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Dislocation systems were analyzed numerically with 1 and 3 glide axes, at T=0 and T>0, with and without climb. [1] Dislocation free domains formed even without shear, defined by dislocation rich domain walls. The domain formation was most pronounced in the presence of climb, somewhat counter-intuitively. The stability of domains was analyzed. The microscopic processes suppressing the climb-induced decay of domain walls were identified. The dislocation dynamics at low temperatures was markedly glassy. Aging: Dislocations with glide only support minimal domain formation. The autocorrelation function showed aging, scaling with the waiting time as: \( C(t,t_w) = C_{eq}(t) C(t/t_w^{\mu}) \) and \( C_{eq}(t) \sim t^{-\beta} \), with \( \mu=0.65 \) and \( \beta=0.54 \). Freezing: The effective diffusion constant decayed to zero as: \( D(t)_{eff} \sim t^{-\gamma} \), with \( \gamma=0.8 \). Coarsening: Dislocations with glide and climb exhibited profound domain formation, the domains coarsening as \( L(t) \sim t^{1/z} \), with \( 1/z=0.17 \). The formation of domains without shear has been recently observed in GaAs by Rudolph and in dusty plasmas by Quinn and Joree. The domain coarsening was quantitatively captured in di-block copolymers [2], with \( 1/z=0.19 \), in good agreement with our results.